

FORM PTO-1390  
(REV. 5-93)U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICEATTORNEY'S DOCKET NUMBER  
10191/1520TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/622652 ✓

INTERNATIONAL APPLICATION NO.  
PCT/DE98/02885 ✓INTERNATIONAL FILING DATE  
30 September 1998 ✓  
(30.09.98)PRIORITY DATE CLAIMED:  
20 February 1998 ✓  
(20.02.98)TITLE OF INVENTION  
METHOD FOR TRANSMITTING USEFUL OPTICAL SIGNALS AND AN OPTICAL NETWORK ✓APPLICANTS FOR DO/EO/US  
KOEPPEN, Jan; NEUMANN, Guenter; TILTMANN, Helmut ✓

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made, however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor (35 U.S.C. 371(c)(4)) (unsigned)
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

## Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: Translation of the International Search Report, PCT/RO/101, International Preliminary Examination Report, translation of the International Preliminary Examination Report.

Express Mail No.:

EA 302 700 882

U.S. APPLICATION NO. if known, see 37 CFR 1.55

09/7622652

INTERNATIONAL APPLICATION NO.  
PCT/DE98/02885ATTORNEY'S DOCKET NUMBER  
10191/1520

- 17.
- ☒
- The following fees are submitted:

**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO, or JPO ..... \$840.00  
 International preliminary examination fee paid to USPTO (37 CFR 1.482) .... \$670.00  
 No international preliminary examination fee paid to USPTO (37 CFR 1.482)  
 but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$760.00  
 Neither international preliminary examination fee (37 CFR 1.482) nor international  
 search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$970.00  
 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all  
 claims satisfied provisions of PCT Article 33(2)-(4) ..... \$96.00

CALCULATIONS | PTO USE ONLY

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$840

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months  
 from the earliest claimed priority date (37 CFR 1.492(e)).

\$

Claims

Number Filed

Number Extra

Rate

Total Claims

21 - 20 =

1

X \$18.00

\$18

Independent Claims

2 - 3 =

0

X \$78.00

\$0

Multiple dependent claim(s) (if applicable)

+ \$260.00

\$

**TOTAL OF ABOVE CALCULATIONS =**

\$858

☒ Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must  
 also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

**SUBTOTAL =**

\$858

☒ Processing fee of \$130.00 for furnishing the English translation later the ☐ 20 ☐ 30  
 months from the earliest claimed priority date (37 CFR 1.492(f)).

+

\$

**TOTAL NATIONAL FEE =**

\$858

☒ Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
 accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

+

\$

**TOTAL FEES ENCLOSED =**

\$858

Amount to be:

refunded

\$

charged

\$

- a. ☐ A check in the amount of \$\_\_\_\_\_ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of \$858.00 to cover the above fees.  
 A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to  
 Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b))  
 must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Kenyon &amp; Kenyon

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New York, New York 10004

SIGNATURE

Richard L. Mayer, Reg. No. 22,490

NAME

DATE

[10191/1520]

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventors : Jan KOEPPEN et al.  
Serial No. : To Be Assigned  
Filed : Herewith  
For : METHOD FOR TRANSMITTING USEFUL OPTICAL  
SIGNALS AND AN OPTICAL NETWORK  
Examiner : To Be Assigned  
Art Unit : To Be Assigned

Assistant Commissioner for Patents  
Washington, D.C. 20231

**PRELIMINARY AMENDMENT**

SIR:

Kindly amend the above-identified application before examination, as set forth below.

**IN THE SPECIFICATION:**

Please amend the specification as follows:

On page 1, before line 1, insert:

--FIELD OF THE INVENTION--.

On page 1, line 1, before "invention", insert --present--.

On page 1, delete line 3, and insert:

--optical line paths and relates to an optical--.

On page 1, before line 6, insert:

--BACKGROUND INFORMATION--.

On page 1, line 31, replace "the" (second occurrence) with --a--.

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On page 1, line 32, replace “known” with --conventional--.

On page 2, delete line 3, and insert:

--European Patent No. 0 440 276 describes adding, outside--.

On page 2, delete line 18, and insert:

--SUMMARY OF THE INVENTION

The present invention provides for--.

On page 2, line 34, replace “at all necessary or cannot be at all” with --necessary or not--.

On page 2, line 35, replace “should” with --may--, and delete “preferably”.

On page 2, line 37, replace “path” with --path, for example--.

On page 3, line 4, delete “thus”.

On page 3, line 7, replace “therefore based” with --based, at least in part,--.

On page 3, delete lines 13-14, and insert:

--a method for optical transmission includes at least one of the following features:--.

On page 4, line 4, replace “therefore rests” with --provides--.

On page 4, line 5, delete “in the fact”.

On page 4, line 9, before “invention”, insert --present--.

On page 4, line 18, before “invention”, insert --present--.

On page 4, line 20, delete “thus”.

[illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible]

[illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible]

including a normal line path and an alternate line path according to the present invention.

Figure 2b depicts optical line segments arising from the second embodiment according to the present invention.

Figure 2c depicts a first configuration of test segments arising from the second embodiment according to the present invention.

Figure 2d depicts a second configuration of the test segments arising from the second embodiment according to the present invention.

Figure 3 depicts a simplified schematic representation of a test signal node according to the present invention.

Figure 4 depicts a flowchart illustrating the formation of test signals for a test signal transmitter of a test signal node according to the present invention.--.

On page 8, before line 31, insert:

--DETAILED DESCRIPTION--.

On page 10, line 22, replace “must react” with --reacts--.

On page 10, line 34, replace “a different” with --another--.

On page 11, line 30, replace “3d” with --2d--.

On page 11, line 31, delete “now”.

On page 12, line 11, replace “d” with --2d--.

On page 13, line 7, replace “one preferred embodiment” with --an exemplary embodiment according to the present invention--.

On page 13, line 8, replace “namely” with --namely,--.

On page 13, line 15, replace “contain” with --include--.

On page 13, line 19, replace “namely” with --namely,--.

On page 13, line 34, replace “in accordance with” with --as illustrated in--.

On page 14, line 15, replace “according to” with --illustrated in--.

On page 14, line 20, replace “example” with --exemplary embodiment--.

On page 15, line 3, replace “expedient” with --advantageous--.

On page 16, line 6, replace “required” with --used--.

On page 16, line 20, replace “example” with --example,--.

On page 18, line 17, replace “the advantage” with --an advantage in--.

On page 18, line 20, replace “is” with --may be--.

On page 18, line 21, delete “advantageously”.

On page 20, delete line 1, and insert:

--What Is Claimed Is:--.

**IN THE ABSTRACT:**

Please amend the Abstract, as follows:

Delete lines 1-34, and insert:

-- Abstract Of The Disclosure

The control of the transmission of useful optical signals on different line paths of an optical transmission device is accomplished via at least one of the following features: using signal sources and signal sinks, the useful optical signals are coupled into the line paths, or are coupled out of them; at least one portion of the optical line paths is configured as normal line paths having coupling nodes via which a switchover to an alternative line path can be undertaken if a normal line path is disturbed; in addition to the useful optical signals, test signals, whose evaluation is used for the switchover between the line paths, are transmitted bidirectionally section-by-section; at least two types of test signals can be transmitted, of which a first type is used as an indicator for an intact line path and a second type as an indicator for a disturbed line path; and any switchover to an alternative line path is only undertaken if, before the detection of the disturbance, a test signal of the first type has been transmitted on the normal line path. A decentralized switchover of the line paths is provided and pointless switchovers, which do not lead to any improvements in the transmission, can be avoided.--.

#### **IN THE CLAIMS:**

Please cancel original claims 1-25, without prejudice. Please also cancel, without prejudice, claims 1-21 of the revised pages of the Annex to the International Preliminary Examination Report.

Please add the following new claims:

- 22. (New) A method for transmitting useful optical signals, comprising the steps of:
- providing an optical transmission device between a first transceiver and a second transceiver, the first transceiver including at least one of a first signal source and a first signal sink, the second transceiver including at least one of a second signal source and a second signal sink, the optical transmission device including at least one normal segment and at least one alternative segment, the at least one normal segment and the at least one alternative segment running parallel;
  - intercoupling the at least one normal segment, the at least one alternative segment, the first transceiver and the second transceiver via at least two coupling nodes;

generating, receiving and recognizing optical test signals section by section via at least four test signal nodes, the optical test signals being in addition to the useful optical signals and including at least a first type of the optical test signals, a second type of the optical test signals and a third type of the optical test signals, the third type including the optical test signals that are not of the first type and not of the second type, the at least four test signal nodes including at least two test signal nodes and at least two additional test signal nodes, the at least two test signal nodes being arranged at ends of the at least one normal segment, the at least two additional test signal nodes being arranged at ends of the at least one alternative segment;

transmitting the optical test signals via the optical transmission device;

detecting a disturbance of the optical transmission device by receiving the third type via a test signal node of the at least four test signal nodes; and

switching over between the at least one normal segment and the at least one alternative segment via the at least two coupling nodes,

wherein the step of switching over between the at least one normal segment and the at least one alternative segment includes the step of switching over from a particular normal segment to a particular alternative segment via a particular coupling node, the particular coupling node being coupled to a closest test signal node of the particular normal segment via a control unit, and

wherein the step of switching over from the particular normal segment to the particular alternative segment occurs when, before receiving the optical test signal of the third type, the closest signal node of the particular normal segment receives the optical test signal of the first type.

23. (New) The method according to claim 22, further comprising the step of:

configuring the at least four test signal nodes as at least one of transit nodes, inception nodes and end nodes.

24. (New) The method according to claim 22, further comprising the steps of:

providing the optical transmission device with at least one segment, the at least one segment including the at least one normal segment and the at least one alternative segment;

recognizing the disturbance of a particular segment of the at least one segment; and  
transmitting the optical test signal of the second type on all segments of the at least one segment excluding the particular segment.

25. (New) The method according to claim 22, further comprising the step of:  
transmitting the optical test signals by the test signal node as a function of the optical test signals received by the test signal node.
26. (New) The method according to claim 25, further comprising the step of:  
influencing, via a superordinate control, the transmitting of the optical test signals by the test signal node.
27. (New) The method according to claim 25, further comprising the step of:  
configuring the test signal nodes via a superordinate control.
28. (New) The method according to claim 25, further comprising the step of:  
supplying information, via the test signal nodes to a superordinate control, relating to the optical test signals received by the test signal node.
29. (New) The method according to claim 28, further comprising the step of:  
using a coupling node that adjoins the test signal node as a superordinate control.
30. (New) The method according to claim 22, wherein the transmitting of useful optical signals is accomplished bidirectionally.
31. (New) The method according to claim 22, wherein the step of transmitting the optical test signals includes the step of bidirectionally transmitting the optical test signals.
32. (New) The method according to claim 30, wherein the bidirectionally transmitting of useful optical signals includes the step of using separate optical line fibers for

bidirectionally transmitting useful optical signals.

33. (New) The method according to claim 32, further comprising the step of:  
transmitting the optical test signals in both transmission directions  
together with transmitting the useful optical signals in a particular direction.
34. (New) The method according to claim 33, further comprising the steps of:  
transmitting a multiplicity of useful signals via a multiplex operation on  
each segment of the optical transmission device in each direction; and  
assigning to each transmitted useful signal its own optical test signal.
35. (New) The method according to claim 34, further comprising the steps of:  
detecting a state “test signal not present” using a test signal level  
detector of the test signal node in response to an undershooting of a level of the  
optical test signal; and  
transmitting the test signal of the third type by the test signal node in at  
least one direction.
36. (New) An optical network, comprising:  
a first transceiver, the first transceiver including at least one of a first  
signal source and a first signal sink;  
a second transceiver, the second transceiver including at least one of a  
second signal source and a second signal sink;  
an optical transmission device including at least one normal segment and  
at least one alternative segment, the optical transmission device being arranged  
between the first transceiver and the second transceiver, the at least one normal  
segment and the at least one alternative segment running parallel;  
at least two coupling nodes intercoupling the at least one normal  
segment, the at least one alternative segment, the first transceiver and the  
second transceiver, the at least two coupling nodes being adapted such that the  
at least one normal segment is bypassed by a switchover of the at least two  
coupling nodes to the at least one alternative segment; and  
at least four test signal nodes disposed at ends of the at least one normal

segment and disposed at ends of the at least one alternative segment, the at least four test signal nodes including a test signal generator and a test signal receiver, the test signal generator generating at least a first type of test signal, a second type of test signal and a third type of test signal, the third type of test signal including all signals that are not the first type of signal and not the second type of signal, the test signal receiver receiving the first type of test signal, the second type of test signal and the third type of test signal for recognition,

wherein a particular coupling node of the at least two coupling nodes switches over between the at least one normal segment and the at least one alternative segment if, by the test signal receiver of a closest test signal node in connection with the particular coupling node, the third type of test signal is detected in connection with the first type of test signal.

37. (New) The optical network according to claim 36, wherein the at least four test signal nodes include the test signal receivers and the test signal generators in both line directions.

38. (New) The optical network according to claim 36, further comprising:  
a superordinate control system configuring the at least four test signal nodes as at least one of transit nodes, inception nodes and end nodes.

39. (New) The optical network according to claim 38, wherein the at least four test signal nodes include signal connections to the superordinate control system.

40. (New) The optical network according to claim 39, wherein the superordinate control system controls the test signal generators via the signal connections.

41. (New) The optical network according to claim 40, wherein the superordinate control includes a part of an adjoining coupling node of the at least two coupling nodes.

42. (New) The optical network according to claim 36, wherein the test signal receiver includes a test signal level detector, the test signal level detector detecting an undershooting of a threshold level of the test signal as a state “test signal not present,”



**Remarks**

This Preliminary Amendment cancels, without prejudice, original claims 1-25 in the underlying PCT Application No. PCT/DE98/02885. This Preliminary Amendment further cancels, without prejudice, claims 1-21 of the revised pages in the Annex to the International Preliminary Examination Report, and adds new claims 22-42. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

The above amendments to the specification and abstract conform the specification and abstract to U.S. Patent and Trademark Office rules, and do not introduce new matter into the application.

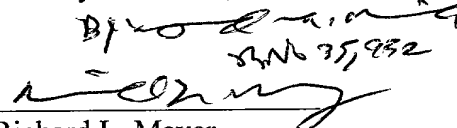
The underlying PCT Application No. PCT/DE98/02885 includes an International Search Report, dated February 17, 1999. The International Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the International Search Report is included herewith. Also enclosed is a translation of the International Search Report.

The underlying PCT Application also includes an International Preliminary Examination Report, dated June 23, 2000. A copy of the International Preliminary Examination Report and corresponding Annex is included herewith. Also enclosed is a translation of the International Preliminary Examination Report and the corresponding Annex.

It is respectfully submitted that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

Dated: 8/21/00

By:   
Richard L. Mayer  
Reg. No. 22,490

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4/PR+5

09/622652  
526 Rec'd PCT/PTC 21 AUG 2000

[10191/1520]

**METHOD FOR TRANSMITTING USEFUL OPTICAL  
SIGNALS AND AN OPTICAL NETWORK**

The invention relates to a method for transmitting useful optical signals in an optical transmission device having optical line paths. The invention also relates to an optical network.

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Optical glass fiber lines have proven to be particularly suitable for the low-loss transmission of information having high information density. Usually information signals in electrical form are converted into optical signals, for example, using light-emitting diodes or laser diodes, and they are coupled into a corresponding optical fiber-optic line. At appropriate locations in the network, the signal is detected, for example, using a photodiode and is once again converted into an electrical signal, such as can be further processed in the customary manner. This signal transmission is well suited for overcoming large distances. At suitable intervals in the appropriate lines, amplifiers and/or regenerators are inserted, which are designed to assure that the signal arrives at the signal sink configured, for example, by the photodiode in an easily receivable form. Just as in the case of electrical networks, it is necessary to provide nodes, through which signals are conveyed to a specific desired receiver and as a result of which it is possible to provide an alternative path for a main line path in the event that the transmission on the main line path is disturbed. As a result of appropriately provided bytes in an overhead of the useful signal to be transmitted, it is also possible to undertake automatic alternative line switching operations. One disadvantage in this method is that the switching operation of an alternative path is only possible within an established transmission standard for the useful signals and that, in the known system, an optoelectronic conversion of the signal is necessary at the ends of the segment that is protected by an alternative path. These ends do not necessarily coincide with

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the sources/sinks of the useful signals.

From European Patent 0 440 276 B1, it is known to add, outside of the useful signal band, a communication signal, using optical couplers. As a result, control and command signals can be transmitted between the nodes of the transmission device. Whereas the transmission of useful signals takes place in the so-called "third window," the "second window" has been provided for the transmission of communications signals. The "windows" arise from the damping characteristics of the glass fiber material for certain wavelength ranges. In the "third window," the damping is minimal, whereas the "second window" is formed using a different damping minimum, in which the lower damping values of the "third window" are not attained. For service communications on the line network, a dedicated transmission band is therefore made available.

One concept of the applicant, not pre-published, provides for transmitting bidirectional test signals on the line paths, connected to each other, of an optical path between signal source and sink and, if appropriate, on individual line segments of the line paths, the reception or non-reception of the test signals being evaluated as an indicator for a line disturbance on a line segment. By forestalling the transmission of the test signal in the opposite direction, it is possible to initiate an alarm upstream in the transmission direction or to trigger a switchover of a node to an alternative path. The decentralized switchover to alternative paths, made possible in this manner, can be carried out orders of magnitude faster than is the case via a centralized control system. This advantage, however, is linked to the problem that even slight and predictable disturbances trigger switchover operations and, as a result, activate alternative paths that are not at all necessary or cannot be at all helpful, so that the alternative paths should be used preferably for a communication having lower priority or as a protective measure for a different normal line path. In particular, there is

nothing to prevent switchover operations from taking place on an optical path that, in any case, is no longer usable due to a detected disturbance, so that unnecessary switchover operations and thus unnecessary occupations of alternative paths occur.

The present invention is therefore based on the general problem of making possible a rapid switchover to alternative line paths, while at the same time avoiding pointless switchover operations.

For solving this problem, according to the present invention, a method for optical transmission of the type mentioned above is characterized by following features:

- using signal sources and signal sinks, the useful optical signals are coupled into the line paths, or are coupled out of them;
- at least one portion of the optical line paths is configured as normal line paths having coupling nodes, via which a switchover to an alternative line path can be undertaken if a normal line path is disturbed;
- in addition to the useful optical signals, test signals, whose evaluation is used for the switchover between the line paths, are transmitted bidirectionally section-by-section;
- at least two types of test signals can be transmitted, of which a first type is used as an indicator for an intact line path and a second type as an indicator for a disturbed line path, and
- any switchover to an alternative line path is only undertaken if, before the detection of the disturbance, a test

signal of the first type has been transmitted on the normal line path.

The method according to the present invention therefore rests in the fact that test signals of at least two types are generated and that the switchover depends not only on the absence of a test signal -- as an indicator of the disturbance -- but rather on the type of test signal previously received. In this manner, the invention makes it possible in a controlled manner to avoid switchover operations, as result of the fact that test signals of the second type are transmitted over a line path, because these test signals of the second type suppress protective measures such as switchovers on the line path. As result of the transmission of a test signal of the second type, it is possible, for example, to prevent switchover operations in an optical path which, on the basis of an already detected disturbance, is currently no longer usable. In addition, the invention makes it possible to undertake the supplying of the test signal of the second type from a superordinate control system and thus, for predictable disturbance events, for example, transit a further useful signal channel in the network, to avoid interference signals that are brought about in the present useful signal channels and that experience shows are short-term.

The present invention therefore makes possible the rapid, decentralized switchover by coupling nodes while simultaneously controlling for the sensibleness of a switchover of this type and also simultaneously avoiding pointless switchovers.

In order to carry out the invention, test signal nodes are advantageously provided at the ends of each line segment, through which specific test signals are received, new test signals are formed and transmitted, or test signals are only

conveyed further.

In this context, consideration is given to the fact that the test signal nodes, depending on the prevailing configuration of an optical path, sometimes border a line segment that is simultaneously a test signal segment, and sometimes, within a test signal segment, are not supposed to exercise the function of influencing the test signals. In one preferred embodiment of the present invention, the test signal nodes are constructed so as to be essentially identical and, through software, are configured as transit nodes, inception nodes, or end nodes. In an end node, test signals in both transmission directions are received, evaluated, generated once again, and transmitted. An end node is located at a signal sink or signal source and is therefore only effective, from the point of view of the end node, for reception and transmission in one direction. A transit node does not alter the received test signals, but it can determine whether a test signal has not been received, since it, in this case, advantageously produces and transmits a particular test signal, preferably of the third type.

In order to avoid switchover operations on an optical path that is no longer usable due to a detected disturbance, in accordance with one preferred embodiment of the invention, it is provided that, from a plurality of line paths connected to each other, one optical path between the two signal sources or sinks is formed and, in response to a detected disturbance on a line path, a test signal of the second type is transmitted on all other line paths of the optical path.

If the test signal nodes recognize a test signal of a third type, or if no test signal at all is received at the test signal node, then a switchover to an alternative line path is only undertaken if a transition is detected from the test

signal of the first type to the test signal of the third type.

The test signal nodes are advantageously connected via signals to a superordinate control system, which also controls the configuration of the test signal nodes in the individual case. The superordinate control system can be configured in a decentralized manner by control systems of the coupling nodes located closest to the test signal node.

One preferred application area of the present invention lies in communications networks, in which the transmission of useful optical signals also takes place in a bidirectional manner, the transmission of the useful optical signals being able to take place over separate optical fiber optic lines in both transmission directions.

The test signals according to the present invention are advantageously transmitted together with the useful signals transmitted in the direction in question.

In general, a plurality of useful signals is transmitted on optical fiber lines in a multiplex operation, preferably in wavelength division multiplexing. In this context, each transmitted useful signal advantageously has assigned to it its own test signal and is transmitted in a separate test signal channel. The test signals are advantageously combined electrically in the time-division multiplex operation and are then optically added to the useful signals in wavelength division multiplexing.

For solving the above-mentioned general problem, an optical network having the following features functions according to the present invention:

- between optical signal sources/sinks, optical paths are

arranged,

- the optical paths are composed of line paths that are connected to each other,

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- the line paths are connected to each other via coupling nodes,

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- some of the line paths can be bypassed as normal line paths by a switchover from coupling nodes to alternative line paths,

- all line paths and, optionally, line segments making up a part of the line paths, are, in each case, bordered by test signal nodes,

- the test signal nodes have test signal receivers and test signal transmitters in both line directions,

- the test signal nodes are provided with a test signal generator and a control system of the test signal generator for generating at least two different types of test signals, as a function of the test signal received by the test signal receivers, and

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- a control system for the coupling nodes is only set up for the switchover to an alternative line path when a disturbance of a normal line path can be detected in connection with a specific type of test signal.

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In this context, the control system is preferably part of the corresponding coupling node.

The test signal nodes are preferably configured for transmitting three types of test signals and are able, at the

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test signal receivers, to detect four different states, namely

the reception of the three test signals and a non-reception of a test signal, in that, 'using a test signal detector, for example, the undershooting of a level of the test signal, or an insufficient edge steepness, or an entirely false test sum is detected as a disturbance and a corresponding disturbance recognition signal is generated. At the disturbance recognition signal, an alarm device can be triggered.

The invention is explained in greater detail below on the basis of the exemplary embodiments depicted in the drawing. The following are the contents:

Figure 1 depicts a schematic representation of an optical path composed of normal line paths connected to each other, having an alternative line path

Figure 2 depicts a representation according to Figure 1 of a different exemplary embodiment of an optical path, having feedback-control and alternative line paths

Figure 3 depicts a schematic representation of the basic design of a test signal node

Figure 4 depicts a flowchart for the formation of test signals for the test signal transmitter of a test signal node, as a function of the test signals received by the test signal receivers.

Figure 1a depicts an exemplary embodiment for an optical path OP between two transmitters/receivers TxRx, each of which is connected to test signal nodes LS1, LS6 forming circuit points 1 and 6. First coupling node OCC1 is connected to transmitter/receiver TxRx at circuit point 1. With regard to

the depicted optical path, first node OCC1, at its output facing away from circuit point 1, has a test signal node LS2 at circuit point 2. A line path 2-3 is connected, which terminates at circuit point 3 in a test signal node LS3.

5 Connected to this is a second coupling node OCC2, which makes possible a branching and has two connections to line points 4 and 7, at which test signal nodes LS4 and LS7 are located. Line point 4, along with a distant line point 5, forms a normal line path 4-5, which at a test signal node LS5, ends in  
10 a subsequent fourth coupling node OCC4. This coupling node has a further connection to a line point 10 having a test signal node LS10, at which an alternative line path 7-10 ends. In the alternative line path, in the depicted exemplary embodiment, a third coupling node OCC3 is connected, which is provided on both sides at line points 8 and 9 with test signal nodes LS8, LS9.

The other end of fourth coupling node OCC4 is connected to transmitter/receiver TxRx, terminating the optical path in  
20 test signal node LS6.

Figure 1b clarifies the optical line segments arising therefrom, 1-2, 2-3, 3-4, 4-5, 5-6, 7-8, 8-9, 9-10, the line segments between line points 7 and 10 forming an alternative  
25 line path for normal line path 4-5.

Figure 1c makes clear that for monitoring this line configuration in the event of a functioning normal path 4-5, only three test segments 1-3, 3-6, 7-10 are necessary, so that  
30 test signal nodes LS2, LS4, LS5, LS8, and LS9 can be configured as transit nodes, which do not process a test signal but rather convey it further.

The test signal segments are formed according to the following  
35 rules:

- at all sources and sinks S/D of useful signals, a test signal segment always begins and ends

- at the beginning and ending of all passive transmission paths, a test signal segment always begins/ends

- at the beginning/ending of a normal line path protected by an alternative line path, a test signal segment always begins/ends. The optical segment in the node at the beginning/ending of a test signal segment constitutes one unit along with the test signal segment of the corresponding active transmission path.

All test signal nodes that are not required at the ending of a test signal segment are configured as transit nodes, i.e., the test signal is only conveyed further.

If the absence of a test signal LS is established on test segment 1-3, then no alternative path is available, so that an alarm is transmitted to a central network control system (Telecommunication Management Network). The user of the network control system must react to the line failure.

On the other hand, if the test signal on normal line path 3-6 fails, coupling nodes OCC2 and OCC4 are induced to switch over and the test signal nodes are reconfigured, so that now test signal nodes LS4 and LS5 are configured as inception nodes for testing the repair of test segment 4-5, whereas test signal nodes LS7 and LS10, heretofore active as inception nodes, can be configured as transit nodes. Test segment 3-6 now forms the active alternative line path, whereas normal line path 4-5 is no longer used.

Figure 2a depicts a different exemplary embodiment for an optical path OP between two transmitters/receivers TxRx having

test signal nodes LS1', LS6' at line points 1', 6'. A first coupling node OCC1' forms a branching leading to two line points 2', 7' having corresponding test signal nodes LS2', LS7'. A second coupling node OCC2' is arranged as a crossing separating filter between normal line paths 1'-4', 3'-6' and alternative line paths 7'-8', 9'-10', and it has four connections to circuit points 3', 4', 8', 9' having test signal nodes LS3', LS4', LS8', LS9'.

A third coupling node OCC3' brings together at line point 6' the two line paths that arrive at line points 5', 10' having test signal nodes LS5', LS10'.

Figure 2b schematically depicts optical line segments 1'-2', 2'-3', 3'-4', 4'-5', 5'-6', 7'-8', 9'-10', derived therefrom.

Figure 2c depicts the test segments of the arrangement according to Figure 2a for the undisturbed case.

From the above rules, it can be seen that a line segment can belong to a plurality of test segments, as is demonstrated also in Figure 2c for line segment 3'-4'. The test segments in Figure 2c are line segments 1'-4', 3'-6', 7'-8', and 9'-10'. The active transmission takes place on line segments 1'-2'-3'-4'-5'-6'. Line segments 7'-8' and 9'-10' represent initially passive alternative line paths.

If a disturbance resulting from the failure of the test signal is established on normal line 1'-4', then a switchover is caused, which is depicted in Figure 3d. Segment 2'-3' is passively connected and the active transmission now takes place on alternative line path 7'-8' from circuit point 1' to line point 4'. Other alternative line path 9'-10', in this case, is not needed as an alternative line path, and is therefore not made active. The test segments now run from 1'

to 4' via line points 7' and 8', on the one hand, and from 8' via 4', 5' to line point 6', on the other hand. In addition, passive paths 2'-3' and 9'-10' are tested for the preservation or reinstatement of functionality.

5

From Figure 2d, it clear that on the basis of the present invention, only a truly necessary alternative line path is actively connected and that this active connection is achieved through the depicted formation of test segments and the testing of test signals at the ends of the test segments. The comparison of Figures 2c and d also makes it clear that, in the normal case, test signal nodes (LS7', LS8'), functioning as inception nodes, are connected as transit nodes, and that test signal node LS2', originally connected as a transit node, is connected as an inception node, if a new configuration is required, e.g., in accordance with Figure 2d, opposite Figure 2c. For test signal nodes LS3', LS4', located on overlapping test segments, one configuration is possible as a transit node in one direction and as an inception node in the other direction.

As a result of the present invention, it is assured that a switchover to an alternative line path only occurs if a switchover of that type can also be expedient. If, for example, in the configuration according to Figure 1a, a disturbance is detected on line path 2-3, then the entire optical path 1-6 is unusable. If, subsequently, yet another disturbance is detected on line path 4-5, a switchover to alternative line path 7-10 would be completely pointless, because this switchover would not lead to a usable optical path 1-6. In many configurations, alternative line path 7-10 is used entirely or partially for other purposes, for example, to carry out a communication having a lower priority or to share in the protection of another normal line path (Shared Protection). This secondary function of alternative line path

7-10 would have to be interrupted if the switchover from normal line path 4-5 to alternative line path 7-10 were undertaken, although as a result nothing would be achieved for the transmission on optical path 1-6. To avoid unnecessary switchovers of this type by test signal nodes LSX, test signals of at least two types are transmitted, and according to one preferred embodiment that is also represented in greater detail below, test signals of three types, namely

- LS-HOT, e.g., as bit pattern 1010
- LS-COLD, e.g., as bit pattern 0101
- LOLS all other bit patterns.

Test signal nodes LSX are also furnished with test signal receivers, which contain a test signal level detector, so that the absence of a test signal -- of whatever type -- is recognized as an individual state. Test signal nodes LSX can therefore distinguish four states on the receiving side, namely "test signal not present" and "test signal received," specifically corresponding to the three possible types of received test signal.

The test signals for the control of switchovers or of other protective measures are utilized according to the present invention on the basis of the rules elaborated below.

In the error-free state, test signal LS-HOT is transmitted on the entire optical path. If, within one line segment, for example, line segment 2-3 in Figure 1a, a fault is recognized as a result of the fact that, for example, test signal node LS2 is no longer receiving a test signal, for example, caused by a fiber interruption for the transmission direction from test signal node LS3 to test signal node LS2, then the test signal node that is configured in accordance with Figure 1c as generally a transit node transmits an LOLS test signal in both

directions.

If the test signal failure on line segment 2-3 were to occur in the other transmission direction, i.e., if it were detected by test signal node LS3 which is configured as an inception node, then the latter would transmit the LOLS test signal only in the reverse direction, i.e., in the direction of test signal nodes LS2 and LS1.

At the ends of line path 1-3, i.e., at test signal nodes LS1 and LS3, a direct transition from test signal LS-HOT to test signal LOLS is detected, so that at these locations a switchover to an alternative line path could be undertaken if an alternative line path of this type were available (as is the case in the exemplary embodiment according to Figure 2a for normal line path 2'-3' through alternative line path 7'-8').

On the basis of the disturbance arising in line path 2-3 in the example depicted in Figure 1a, on all other line paths 1-2, 4-5, 5-6 of the optical path (in this situation, potential alternative line paths 7-8, 9-10 are not connected and therefore do not belong to the present optical path 1-6), test signals of the second type LS-COLD are transmitted. If the loss of the test signal were to be detected, for example, by test signal node 5 on the basis of a disturbance, it would not result in a switchover to alternative line path 7-10 because the switchover would only be effected if a transition from test signal LS-HOT to test signal LOLS took place, which, however, cannot occur due to the transmission of test signal LS-COLD.

The transmission of test signal LS-COLD, which, in this way, prevents a switchover to alternative line path or other protective measures, can also be controlled from outside, for

example, by a coupling node computer, in order to avoid  
inadvisable switchover reactions in the event of a foreseeable  
short-term disturbance. This is expedient, for example, if in  
an existing network configuration a new transmission path for  
5 useful signals (for example, a new wavelength channel) is  
constructed or an existing transmission path is dismantled,  
since, in this context, it is possible that short-term  
disturbances of existing transmission paths can occur. By  
supplying LS-COLD test signals to the optical path,  
10 potentially existing alternative path circuits are "frozen,"  
until the new operating state is reliably established. As a  
result, "chain reactions," as a result of switchovers arising  
one after the other, can also be avoided. In addition, for  
purposes of servicing, an existing network configuration can  
be "frozen," without having to dismantle protective mechanisms  
configured, for example, by a central computer.

Figure 3 schematically depicts the design of the test signal  
node for a bidirectional network, in which separated fiber-  
optic lines are provided for both transmission directions.  
20 Test signal node LSX has two transit sides (E, O) for  
connected line segments. A test signal from side E is received  
by a test signal receiver EW. A test signal can be transmitted  
from a test signal transmitter SW to side E. Correspondingly,  
for transit side O, a test signal receiver EO and a test  
25 signal transmitter SO are provided.

In the depicted exemplary embodiment, test signal node LSX  
also has four inputs from superordinate control systems. Via  
30 an input SendW, a test signal to be transmitted by test signal  
transmitter SW can be input from outside. The same applies for  
an input SendO, which establishes from outside a test signal  
to be transmitted by test signal transmitter SO.

35 At a further input LSTP, LSCP, a configuration signal is input

for test signal node LSX, through which it is established whether test signal node LSX is configured as a transit node (LSCP) or as an inception node (LSTP).

5 If test signal node LSX is an end node of an optical path (e.g., LS1 and LS6 in Figure 1a), it is only required as an end node (LSIP) for one side E or O. This configuration is controlled through an input LSIP. The test signals received from test signal node LSX are output as test signal  
10 information via outputs EmpfW, EmpfO to a superordinate control system, for example, a coupling node computer, so that the coupling node computer can undertake evaluations for the purpose of the switchover to protective measures, the worse state of SO and EO being transmitted on EmpfO and the worse state of SW and EW being transmitted on EmpfW.

15 If test signal node LSX is in the configuration as a transit node (LSCP), the received test signals are retransmitted unchanged (EW = SO; EO = SW). Only if a test signal is not  
20 received, for example at test signal receiver EW, is signal LOLS transmitted in both directions by test signal transmitters SO, SW.

25 If test signal node LSX is configured as an inception node (LSTP), then in response to the failure of reception of a test signal, for example, at test signal receiver EW, it transmits signal LOLS only in the corresponding reverse direction (SW), regularly transmitting the signal (LS-COLD) in the other direction, however, unless the transmission of a worse test  
30 signal (LOLS) is indicated by a test signal from the other direction. Test signal node LSX, receiving signal LOLS transmitted by test signal transmitter SW, and configured as an inception node (LSCP), at the end of the line path that is disturbed in the other transmission direction, regularly  
35 transmits signal LS-COLD in the W direction in response to the

reception of LOLS, so that all line paths not affected by the disturbance transmit signal LS-COLD in the W transmission direction. Test signal nodes LSX, which as inception nodes (LSTP) receive a signal LS-COLD, transmit signal LS-HOT in the opposite direction, if non-corresponding test signal receiver EW simultaneously registers a loss of a test signal, so that corresponding test signal transmitter SO transmits an LS-COLD test signal.

On the basis of the rule that, in the reverse direction, test signal transmitter SO or SW fundamentally transmits a test signal of a higher order (failure test signal  $\Rightarrow$  LOLS ; LOLS  $\Rightarrow$  LS-COLD; LS-COLD  $\Rightarrow$  LS-HOT, assuming an end node (LSIP) is present or LS-HOT has been received on transmitter side), a rapid and automatic reconnection of the normal line paths is permitted after the carrying out of a line repair.

Figure 4 depicts a flow diagram for the generation of the test signals to be transmitted via test signal transmitters SO, SW as a function of the test signals received by test signal transmitters EW, EO.

For a transit node (LSCP), it only remains to be tested whether one of test signal receivers EW or EO signals a test signal failure ("off") or not. If a test signal failure is established, then signal LOLS is transmitted in both directions. If both test signal receivers EW, EO have received a test signal, then the received test signal is once again transmitted unchanged (SW = EO; SO =EW).

If, on the other hand, test signal node LSX is an inception node (LSTP; an end node (LSIP) is a subcase of an inception node (LSTP)), then in response to an established test signal failure (for example, EW = off) signal LOLS (SW = LOLS) is transmitted in the opposite direction. The same applies if the

test signal failure is established by other test signal receiver EO. In this case, test signal LOLS is transmitted by test signal transmitter SO.

5 If a test signal is received by test signal receiver EW, EO, and if this test signal is LOLS, then in accordance with the above rule, test signal LS-COLD (SW = cold or SO = cold) is transmitted in the opposite direction.

10 If the received test signal is not LOLS, then it can only be LS-COLD or LS-HOT. If the input signal of the other side is LS-HOT or if the test signal node is an end node (LSIP), then test signal LS-HOT is transmitted in the opposite direction, otherwise LS-COLD.

The bit patterns cited above as examples for test signals LS-HOT and LS-COLD have the advantage that it is very difficult to confuse the two test signals.

20 The control system for the protective measures is advantageously set such that in state LS-HOT only a small number of other bit patterns (LOLS) suffice to send an alarm to the control computer. In state LS-COLD, an alarm is reported only after a much larger number of falsely received test signal bit patterns. In this manner, it can be avoided that, in state LS-COLD, failures lasting briefly lead to an alarm in the central control system of the network.

30 If the transmission capacity of the test signal channel is selected so as to be sufficiently large, e.g., two MBit/s, then in addition to the test signals described here, other data for controlling and monitoring can also be transmitted independent of the test signals themselves.

35 For the test signal concept according to the present

invention, it is not important how many wavelengths are transmitted simultaneously over one optical fiber, for example, in wavelength division multiplexing, because each wavelength channel has assigned to it its own test signal.

5 Each wavelength can therefore be protected by its own alternative line path.

The protective measures depicted, according to the present invention, are locally controlled, for example, by the  
10 coupling node computer, so that the central control system of the network and the operator do not participate in acute switchover measures.

## New Claims

1. A method for transmitting useful optical signals via an optical transmission device between a first signal source or signal sink (TxRx) and a second signal source or signal sink (TxRx), the optical transmission device having on at least one part of its length at least one normal segment (4-5, 1'-4', 3'-6') and at least one alternative segment (7-10, 7'-8', 9'-10'), running parallel, at least two coupling nodes (OCC1, OCC2, OCC3, OCC4, OCC1', OCC2', OCC3') being provided which interconnect the at least one normal segment (4-5, 1'-4', 3'-6') and the at least one alternative segment (7-10, 7'-8', 9'-10') of the optical transmission device and the first and second signal sources or signal sinks (TxRx), it being possible additionally to undertake a switchover by at least two coupling nodes (OCC2, OCC4, OCC2') between the at least one normal segment and the at least one alternative segment (7-10, 7'-8', 9'-10'), having the following features:

- in addition to the useful optical signals, optical test signals are generated, received, and recognized by test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') section-by-section, and they are transmitted by the optical transmission device, at least two test signal nodes (LS4, LS5, LS1', LS3', LS4', LS6') being arranged at the ends of the normal segment (4-5, 1'-4', 3'-6') and at least two test signal nodes (LS7, LS10, LS1', LS7', LS8') being arranged at the ends of the alternative segment (7-10, 7'-8', 9'-10'),

- at least a first type (LS-HOT), a second type (LS-COLD), and a third type (LOLS) of test signals are generated and transmitted, as well as, upon reception, recognized, the test signal of the third type (LOLS) including all signals that are not a signal of the first or second type (LS-HOT or LS-COLD),

a disturbance of the optical transmission device being detected in response to the reception of a test signal of the third type (LOLS) by one of the at least four test signal nodes (LS4, LS5, LS1', LS3', LS4', LS5', LS6', LS7, LS10, LS1', LS6', LS7', LS8'),

characterized in that

- a switchover of the coupling node (OCC2, OCC4, OCC2'), connected via a control unit to the closest test signal node (LS4, LS5, LS1', LS3', LS4', LS6'), from a normal segment (4-5, 1'-4', 3'-6') to an alternative segment (7-10, 7'-8', 9'-10') is only undertaken when, before the reception of a test signal of the third type (LOLS), a test signal of the first type (LS-HOT) has been received by the closest test signal node (LS4, LS5, LS1', LS3', LS4', LS6') of the normal segment.

2. The method as recited in Claim 1, characterized in that the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') are able to be configured as transit nodes (LSCP), inception nodes (LSTP), or end nodes (LSIP).

3. The method as recited in one of Claims 1 or 2, characterized in that the optical transmission device is composed of a plurality of alternative or normal segments, connected to each other, a test signal of the second type (LS-COLD) being transmitted on all other segments in response to a recognized disturbance on an alternative or normal segment.

4. The method as recited in one of Claims 1 through 3, characterized in that test signals to be transmitted in all test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8',

LS9', LS10') are formed as a function of the received test signals.

5. The method as recited in one of Claims 1 through 4, characterized in that the transmission of test signals by the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') is able to be influenced by a superordinate control.

6. The method as recited in Claims 1 through 5, characterized in that the configuration of the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') is undertaken via the superordinate control.

7. The method as recited in one of Claims 1 through 6, characterized in that information (EmpfO, EmpfW) about the received test signals is supplied by the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9, LS10') to the superordinate control.

8. The method as recited in one of Claims 5 through 7, characterized in that as the superordinate control, the coupling node (OCC2, OCC4, OCC2') adjoining the test signal node (LS4, LS5, LS1', LS3', LS4', LS6', LS7, LS10, LS1', LS6', LS7', LS8') is used.

9. The method as recited in one of Claims 1 through 8, characterized in that the transmission of useful optical signals is accomplished bidirectionally.

10. The method as recited in one of Claims 1 through 8, characterized in that the transmission of optical test signals

(LS-HOT, LS-COLD, LOLS) is accomplished bidirectionally.

11. The method as recited in Claim 9, characterized in that for the transmission of useful optical signals in both transmission directions (O, W), separate optical line fibers are used.

12. The method as recited in Claim 9, 10, or 11, characterized in that the transmission of the test signals in both transmission directions (O, W) takes place together with the transmission of the useful signals in the direction in question.

13. The method as recited in one of Claims 9 through 12, characterized in that on each segment of the optical transmission device in each direction (O, W), a multiplicity of useful signals is transmitted in a multiplex operation, and each transmitted useful signal has its own test signal (LS-HOT, LS-COLD, LOLS) assigned to it.

14. The method as recited in one of Claims 1 through 13, characterized in that, using a test signal level detector of the test signal node (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') a state "test signal not present" is detected in response to the undershooting of a level of the test signal, a test signal of the third type (LOLS) being transmitted thereupon by the test signal node (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') in at least one direction (O, W).

15. An optical network having at least two optical signal sources or optical signal sinks (TxRx), having an optical transmission device, the optical transmission device having on at least one part of its length, at least one normal segment

(4-5, 1'-4', 3'-6') and least one alternative segment (7-10, 7'-8', 9'-10'), running parallel, having at least two coupling nodes (OCC1, OCC2, OCC3, OCC4, OCC1', OCC2', OCC3') and having at least four test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10'), having the following features:

- the optical transmission device is arranged between a first optical signal source or signal sink (TxRx) and a second optical signal source or signal sink (TxRx);

- the at least one normal segment (4-5, 1'-4', 3'-6') and the least one alternative segment ((7-10, 7'-8', 9'-10')) of the optical transmission device and the at least two optical signal sources and signal sinks (TxRx) are interconnected via the at least two coupling nodes (OCC1, OCC2, OCC3, OCC4, OCC1', OCC2', OCC3'),

- at least two of the at least two coupling nodes (OCC2, OCC4, OCC2') are configured such that the least one normal segment (4-5, 1'-4', 3'-6') is bypassed by a switchover of the coupling nodes ((OCC2, OCC4, OCC2') to the at least one alternative segment (7-10, 7'-8', 9'-10'),

- the at least one normal segment (4-5, 1'-4', 3'-6') and the at least one alternative segment (7-10, 7'-8', 9'-10') have at their ends, in each case, one of the at least four test signal nodes (LS4, LS5, LS1', LS3', LS4', LS6', LS7, LS10, LS1', LS6', LS7', LS8');

- the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') have a test signal generator for generating at least a first type (LS-HOT) and a second type (LS-COLD) and a third type (LOLS) of test signals, the test signal of the

third type (LOLS) including all signals that are not a signal of the first or second type (LS-HOT or LS-COLD);

- test signal nodes have a test signal receiver, so that the test signals of the first type (LS-HOT), of the second type (LS-COLD), and of the third type (LOLS) can be received and recognized;

characterized in that

- the coupling nodes (OCC2, OCC4, OCC2') having the switchover capacity only undertake the switchover between the at least one normal segment (4-5, 1'-4', 3'-6') and the at least one alternative segment (7-10, 7'-8', 9'-10') of the optical transmission device if, by the test signal receiver of the closest test signal node (LS4, LS5, LS1', LS3', LS4', LS6', LS7, LS10, LS1', LS6', LS7', LS8') in connection with the coupling node (OCC2, OCC4, OCC2'), a test signal of the third type (LOLS) has been detected in connection with a test signal of the first type (LS-HOT).

16. The optical network as recited in Claim 15, characterized in that the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') in both line directions (O, W) have test signal receivers (EO, EW) and test signal generators (SO, SW).

17. The optical network as recited in Claim 15 or 16, characterized in that the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') can be configured by a superordinate control system as transit nodes (LSCP), inception nodes (LSTP), or end nodes (LSIP).

18. The optical network as recited in one of Claims 15 through 17,

characterized in that the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') have signal connections to a superordinate control.

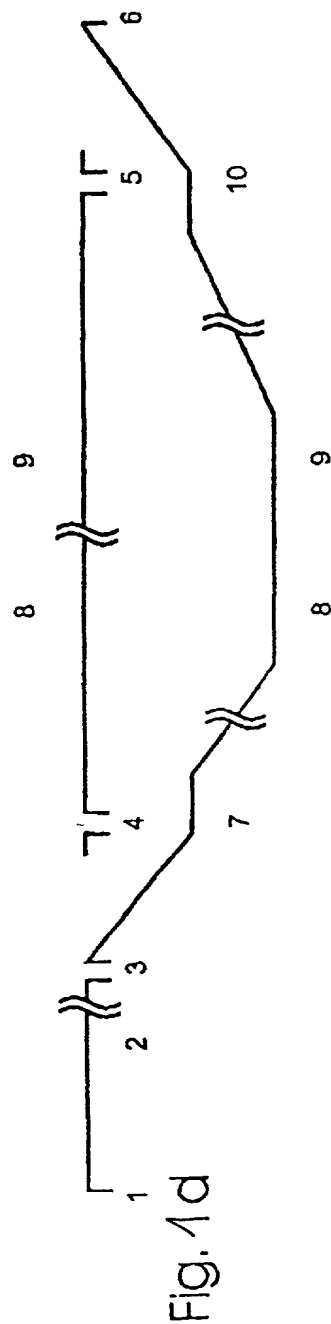
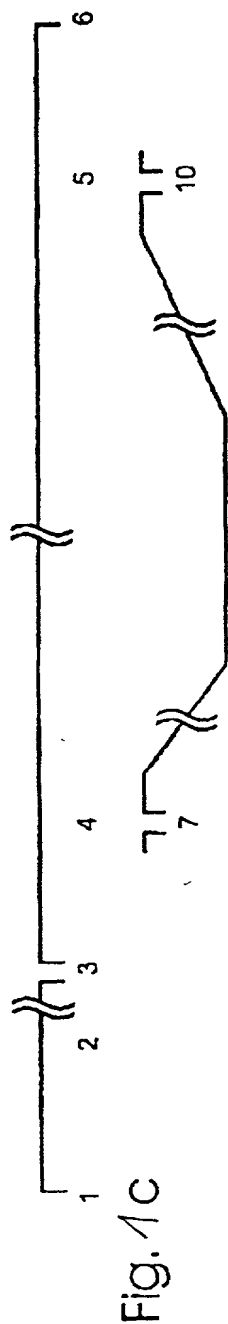
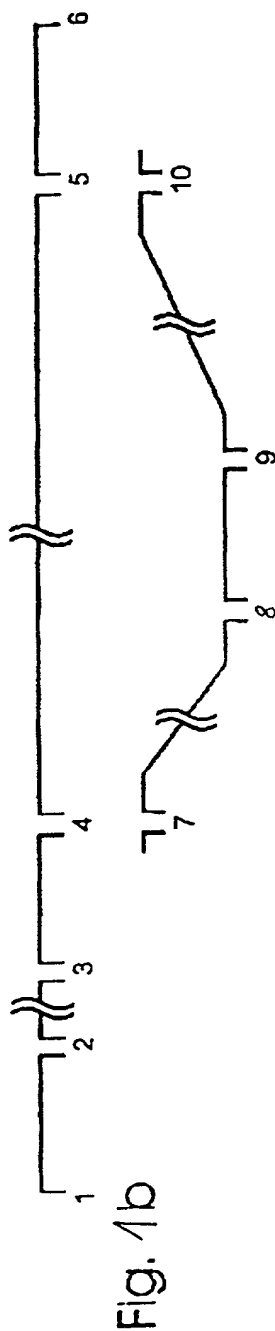
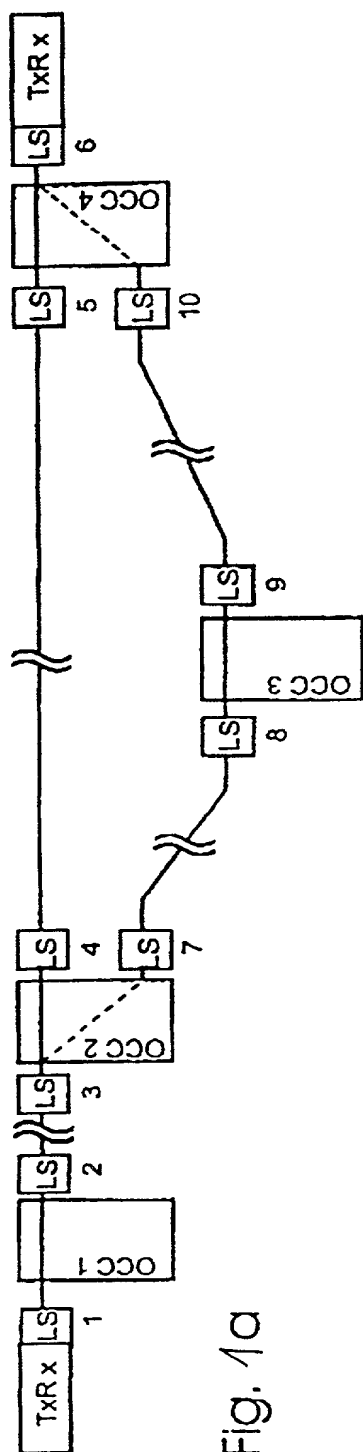
19. The optical network as recited in Claim 18, characterized in that the test signal generators of the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') can be controlled via the signal connection by the superordinate control.

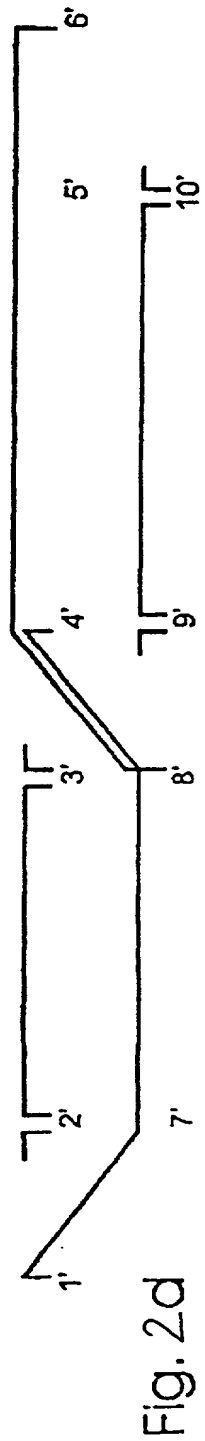
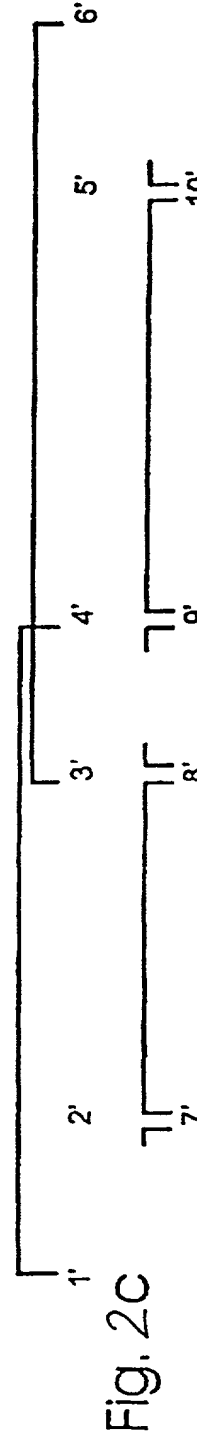
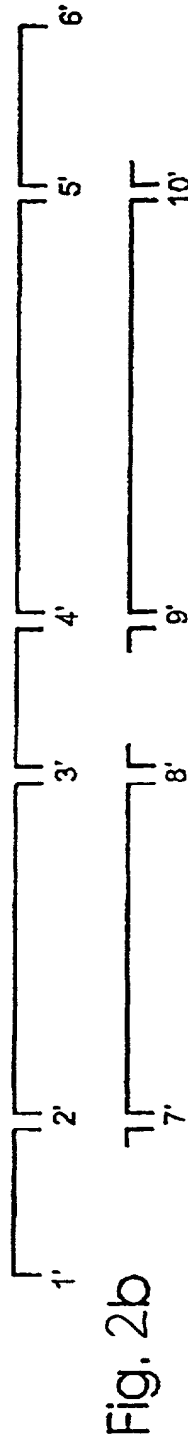
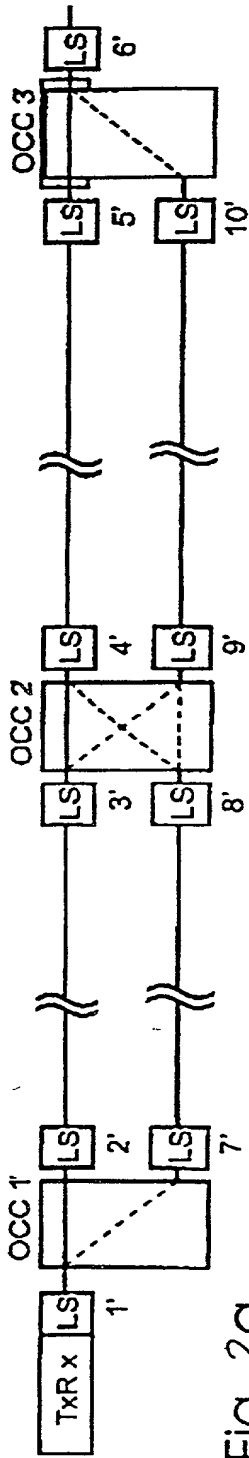
20. The optical network as recited in one of Claims 18 and 19, characterized in that the superordinate control constitutes a part of an adjoining coupling node (OCC2, OCC4, OCC2').

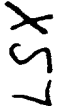
21. The optical network as recited in one of Claims 15 through 20,

characterized in that the test signal receivers (EO, EW) of the test signal nodes (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') are furnished with a test signal level detector, which detects an undershooting of a level of the test signal as the state "test signal not present," a test signal of the third type (LOLS) being thereupon able to be transmitted by the test signal node (LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS1', LS2', LS3', LS4', LS5', LS6', LS7', LS8', LS9', LS10') in at least one direction (O, W).

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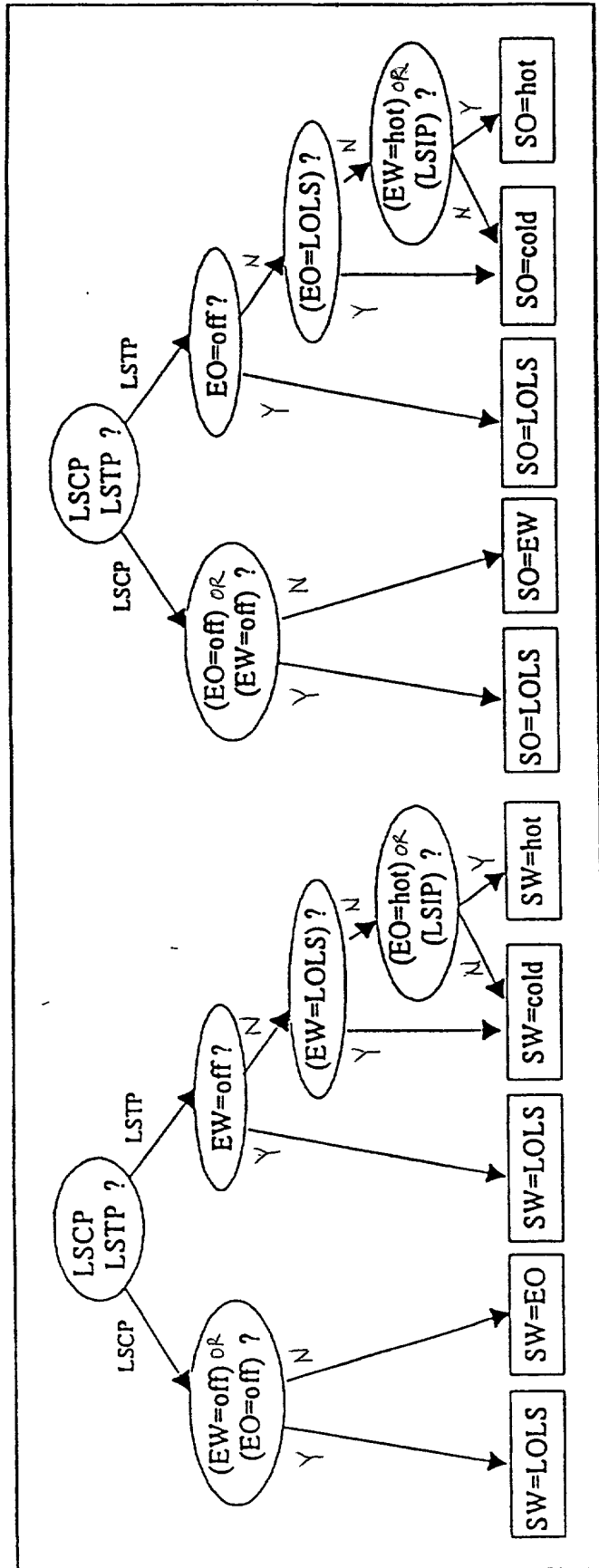


Fig. 4

3rd

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**Figure 1.** Schematic representation of the experimental design. The subjects were divided into two groups: control group and intervention group. The control group received no intervention, while the intervention group received a 6-week intervention program. The intervention program consisted of three components: physical activity, cognitive-behavioral therapy, and social support. The subjects were assessed at baseline, post-intervention, and follow-up. The dependent variables were self-reported stress levels, perceived social support, and quality of life.

PCT Filing Date :

I hereby appoint the following attorney(s) and/or agents to prosecute the above-identified application and transact all business in the Patent and Trademark Office connected therewith.

(List names and registration numbers):

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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File

09/6/2002

[10191/1520]

**COMBINED DECLARATION AND  
POWER OF ATTORNEY FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD FOR TRANSMITTING USEFUL OPTICAL SIGNALS AND AN OPTICAL NETWORK**, and the specification of which:

- ☐ is attached hereto;
- ☐ was filed as United States Application Serial No. \_\_\_\_\_ on \_\_\_\_\_, 19\_\_ and was amended by the Preliminary Amendment filed on \_\_\_\_\_, 19\_\_.
- ☒ was filed as PCT International Application Number PCT/DE98/02885, on the 30th day of September, 1998.
- ☒ an English translation of which is filed herewith.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at

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least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

**PRIOR FOREIGN/PCT APPLICATION(S)  
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country : Federal Republic of Germany

Application No. : 198 070 69.1

Date of Filing : 20 February 1998

Priority Claimed

Under 35 U.S.C. § 119 : ☒ Yes    ☐ No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS OR  
PCT INTERNATIONAL APPLICATIONS  
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120**

**U.S. APPLICATIONS**

Number :

Filing Date :

**PCT APPLICATIONS  
DESIGNATING THE U.S.**

PCT Number :